Amendments to the Claims

The following listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims

What is claimed is:

1 - 38 (Canceled).

39. (Previously presented) A method for culturing cells in a reaction system comprising a container for dialysis fluid and a culture vessel for culturing cells, the method comprising:

using a membrane module in fluid communication with the container and the space for culturing cells, the module including at least two spaces separated by a membrane, the membrane functioning as a dialysis membrane;

circulating a dialysis fluid through one of the at least two module spaces;

circulating a culture fluid containing cells through the other of the at least two module spaces;

introducing a first gas into the culture fluid in the space for culturing the cells; and

introducing a second gas into the culture fluid in the membrane module.

40. (Previously presented) The method of claim 39, wherein introducing the second gas includes passing gas directly into the culture fluid present in the membrane module.

41. (Previously presented) The method of claim 39, wherein introducing the second gas includes passing gas indirectly into the culture fluid present in the membrane module.

42. (Previously presented) The method of claim 41, wherein passing gas indirectly includes introducing the second gas into the dialysis fluid in the container for dialysis fluid, wherein the gas passes to the culture fluid present in the membrane module via the membrane of the membrane module.

43. (Previously presented) The method of claim 40, wherein gas is introduced both directly and indirectly at the same time.

44. (Previously presented) The method of claim 41, wherein gas is introduced both directly and indirectly at the same time.

45. (Previously presented) The method of claim 39, including using a membrane module that includes at least one gas supplying means and further comprising supplying at least one of the at least two spaces with the second gas via the gas supplying means.

46. (Previously presented) The method of claim 45, wherein supplying the second gas includes supplying the gas through an outlet located in the membrane module space carrying the culture fluid.

47. (Previously presented) The method of claim 45, wherein supplying the second gas includes supplying the gas through a tube.

48. (Previously presented) The method of claim 45, wherein the supplying the second gas includes supplying the gas through a nozzle outlet.

49. (Previously presented) The method of claim 39, including using a membrane comprising a material selected from the group comprising regenerated cellulose, polyamide, polypropylene and polysulfone.

50. (Previously presented) The method of claim 39, including using a membrane module that is a plate module

51. (Canceled).

52. (Currently amended) The method of ~~claim 51~~ claim 39, wherein the ~~dialysis~~ membrane is formed of Cuprophan.

53. (Previously presented) The method of claim 39, wherein using the membrane module includes selecting a membrane module that provides sufficient gas exchange for the cells.

54. (Previously presented) The method of claim 53, wherein selecting a membrane module that provides sufficient gas exchange includes selecting a membrane module having an adequate area/volume ratio and an adequate gas permeability coefficient.

55. (Previously presented) The method of claim 54, wherein selecting a membrane module that provides sufficient gas exchange includes selecting a membrane module having an area/volume ratio of at least about 5 m^2 per liter.

56. (Previously presented) The method of claim 55, wherein selecting a membrane module that provides sufficient gas exchange includes selecting a membrane module having an area/volume ratio of at least about 10 m^2 per liter.

57. (Previously presented) The method of claim 56, wherein selecting a membrane module that provides sufficient gas exchange includes selecting a membrane module having an area/volume ratio of at least about 13 m^2 per liter.

58. (Previously presented) The method of claim 54, wherein selecting a membrane module that provides sufficient gas exchange includes selecting a membrane module having an oxygen permeability coefficient equal to or greater than about 0.066 cm per minute.

59. (Previously presented) The method of claim 39, wherein the container for dialysis fluid includes at least one of a means for supplying gas and a means for removing gas.

60. (Previously presented) The method of claim 39, further comprising increasing the pressure in at least one of the membrane module, the space for culturing the cells, and the container for dialysis fluid.

61. (Currently amended) The method of claim 39, wherein supplying the first gas includes individually and independently selecting the first gas from the ~~group comprising~~ group consisting of air, oxygen, nitrogen, carbon dioxide and mixtures thereof.

62. (Currently amended) The method of claim 61, wherein supplying the second gas includes individually and independently selecting the second gas from the ~~group comprising~~ group consisting of air, oxygen, nitrogen, carbon dioxide and mixtures thereof.

63. (Previously presented) The method of claim 62, wherein the second gas is oxygen.

64. (Previously presented) The method of claim 62, wherein the second gas is carbon dioxide.

65. (Previously presented) The method of claim 39, wherein the cells are selected from the group comprising microbial cells, fungal cells, animal cells, and plant cells.

66. (Previously presented) The method of claim 65, wherein the cells are Escherichia coli cells.

67. (Previously presented) The method of claim 39, further comprising sterilizing the reaction system.

68. (Previously presented) The method of claim 67, further comprising inoculating the culture vessel with cells to be cultured subsequent to sterilizing the reaction system.

69. (Previously presented) The method of claim 39, further comprising harvesting cultured cells.

70. (Previously presented) A membrane module comprising:

at least two spaces separated by a membrane, wherein a liquid flows through each space, the liquid in one of the at least two spaces being dialysis fluid and the liquid in the other of the at least two spaces being culture fluid; and

at least one gas supplying means, the gas supplying means having an outlet and being located in one of the spaces.

71. (Previously presented) The membrane module of claim 70, wherein the membrane is tubular and the volume of the tubular membrane forms one of the at least two spaces.

72. (Previously presented) The membrane module of claim 71, wherein a diameter of the space formed by the tubular membrane is between about 3 mm and 10 mm.

73. (Previously presented) The membrane module of claim 72, wherein the diameter of the space formed by the tubular membrane is between about 6 mm and 8 mm.

74. (Previously presented) The membrane module of claim 71, wherein the membrane module comprises a plurality of spaces formed by the tubular membrane.

75. (Previously presented) The membrane module of claim 74, wherein at least one of the spaces formed by the tubular membrane includes a gas supplying means outlet.

76. (Previously presented) The membrane module of claim 75, wherein the gas supplying means outlet is located in a space outside the spaces formed by the tubular membrane.

77. (Previously presented) The membrane module of claim 70, wherein the gas supplying means is a tube.

78. (Previously presented) The membrane module of claim 77, wherein the tube is arranged in the space in a concentric manner.

79. (Previously presented) The membrane module of claim 77, wherein an internal diameter of the tube is between about 0.2 mm and about 3 mm.

80. (Previously presented) The membrane module of claim 70, wherein the gas supplying means outlet is shaped like a nozzle.

81. (Previously presented) A method for culturing cells in a reaction system comprising a container for dialysis fluid and a culture vessel for culturing cells, the method comprising:

using a membrane module according to claim 70, wherein the membrane module is in fluid communication with the container and the vessel for culturing cells, the module including at least two spaces separated by a membrane, the membrane functioning as a dialysis membrane;

circulating a dialysis fluid through one of the at least two module spaces;

circulating a culture fluid containing cells through the other of the at least two module spaces;

introducing a first gas into the culture fluid in the space for culturing the cells; and

introducing a second gas into the culture fluid in the membrane module.

82. (Currently amended) A reaction system for culturing cells, comprising:

a container for dialysis fluid;

a culture vessel for culturing cells; and

at least one membrane module inserted in between the container and the culture vessel, ~~said membrane module configured to ensure at least one of~~

~~sufficient gas supply during passage of a culture fluid through the membrane module and sufficient gas exchange in the culture fluid located in the membrane module.~~

wherein the membrane module comprises at least two spaces separated by a membrane, wherein a liquid flows through each space, the liquid in one of the at least two spaces being dialysis fluid and the liquid in the other of the at least two spaces being culture fluid, and the membrane module further includes at least one gas supplying means, the gas supplying means having an outlet and being located in one of the spaces.

83. (Canceled).

84. (Previously presented) The reaction system of claim 82, wherein the container for dialysis fluid contains at least one gas-introducing device.

85. (Previously presented) The reaction system of claim 82, wherein a membrane of the membrane module has a gas permeability coefficient sufficient to ensure sufficient gas supply during passage of the culture fluid through the membrane module.

86. (Previously presented) The reaction system of claim 82, wherein a membrane of the membrane module has a gas permeability coefficient sufficient to ensure sufficient gas exchange in the culture fluid located in the membrane module.

87. (Previously presented) The reaction system of claim 82, wherein a membrane of the membrane module has an area/volume ratio sufficient to ensure adequate gas supply during passage of the culture fluid through the membrane module.

88. (Previously presented) The reaction system of claim 82, wherein a membrane of the membrane module has an area/volume ratio sufficient to ensure adequate gas exchange in the culture fluid located in the membrane module.

89. (Previously presented) The reaction system of claim 82, wherein the membrane module has an area/volume ratio of at least about 5 m^2 per liter.

90. (Previously presented) The reaction system of claim 89, wherein the area/volume ration of the membrane module is at least about 10 m^2 per liter.

91. (Previously presented) The reaction system of claim 90, wherein the area/volume ratio of the membrane module is at least about 13 m^2 per liter.

92. (Previously presented) The reaction system of claim 82, wherein the membrane module has an oxygen permeability coefficient equal to or greater than 0.066 cm per minute.